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Guild et al.

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[54] **PREADJUSTABLE WEB SLITTER AND NON-DEFLECTING MOUNTING THEREFOR**

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[73] Assignee: **Beloit Corporation**, Beloit, Wis.

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[51] **Int. Cl.**[3] **B23D 19/06**

[52] **U.S. Cl.** **83/482;** 83/498; 83/502; 83/503; 83/564

[58] **Field of Search** 83/498, 499, 503–504, 83/528, 564, 482

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[57] **ABSTRACT**

Rigid support for adjustable slitter blade heads enables permanent factory setting of slitting overlap and the rake and toe-in angles. The upper blade is mounted on its blade head for both radial and axial movement relative to the lower blade without requiring resetting of the blade overlap and rake and toe-in angles. The blades are replaceable without requiring resetting of the blade cutting overlap and rake and toe-in angles. Full adjustment of the blade supporting heads across the web path is provided for. Setting efficiency is greatly improved.

23 Claims, 6 Drawing Figures

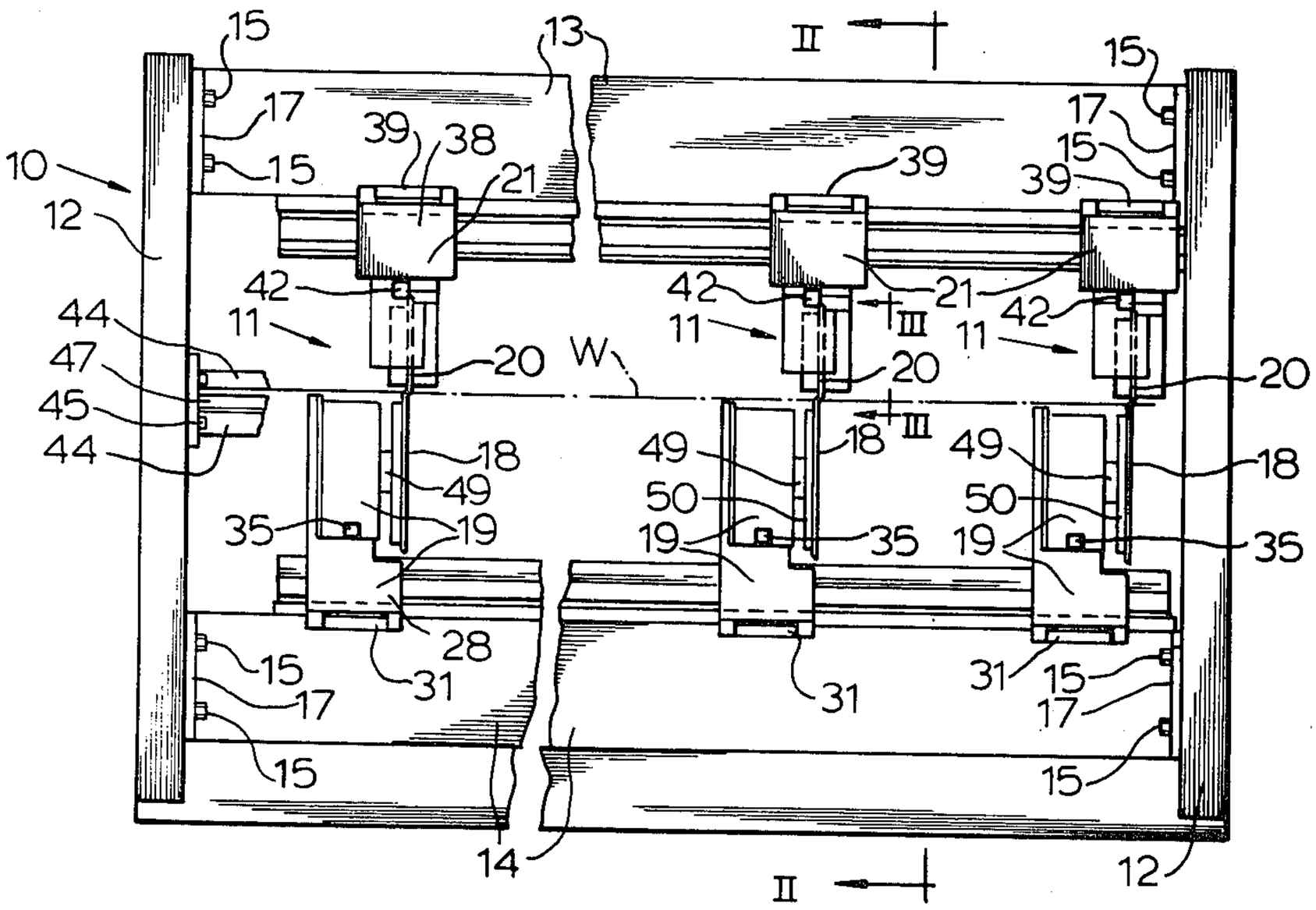
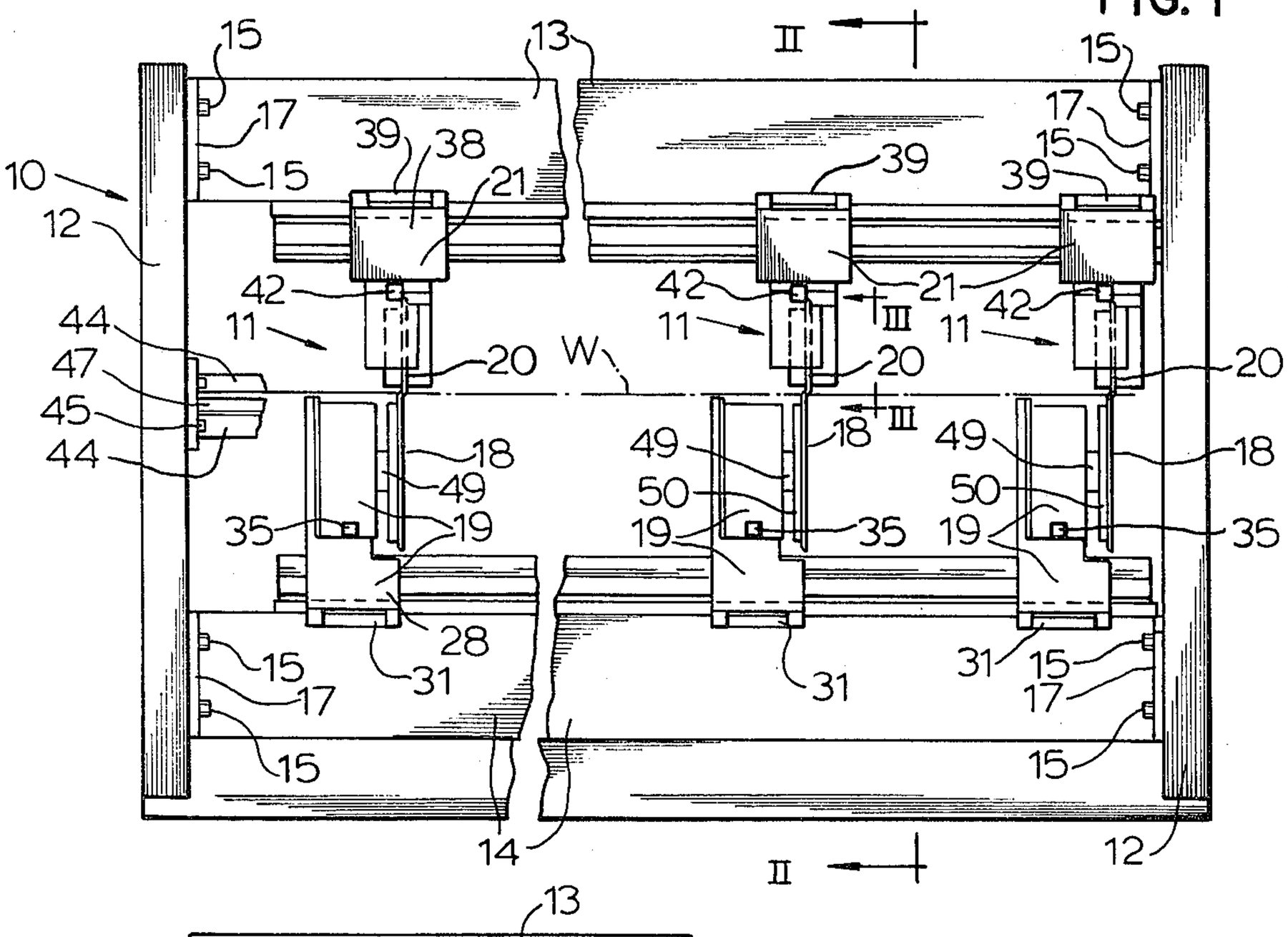


FIG. 1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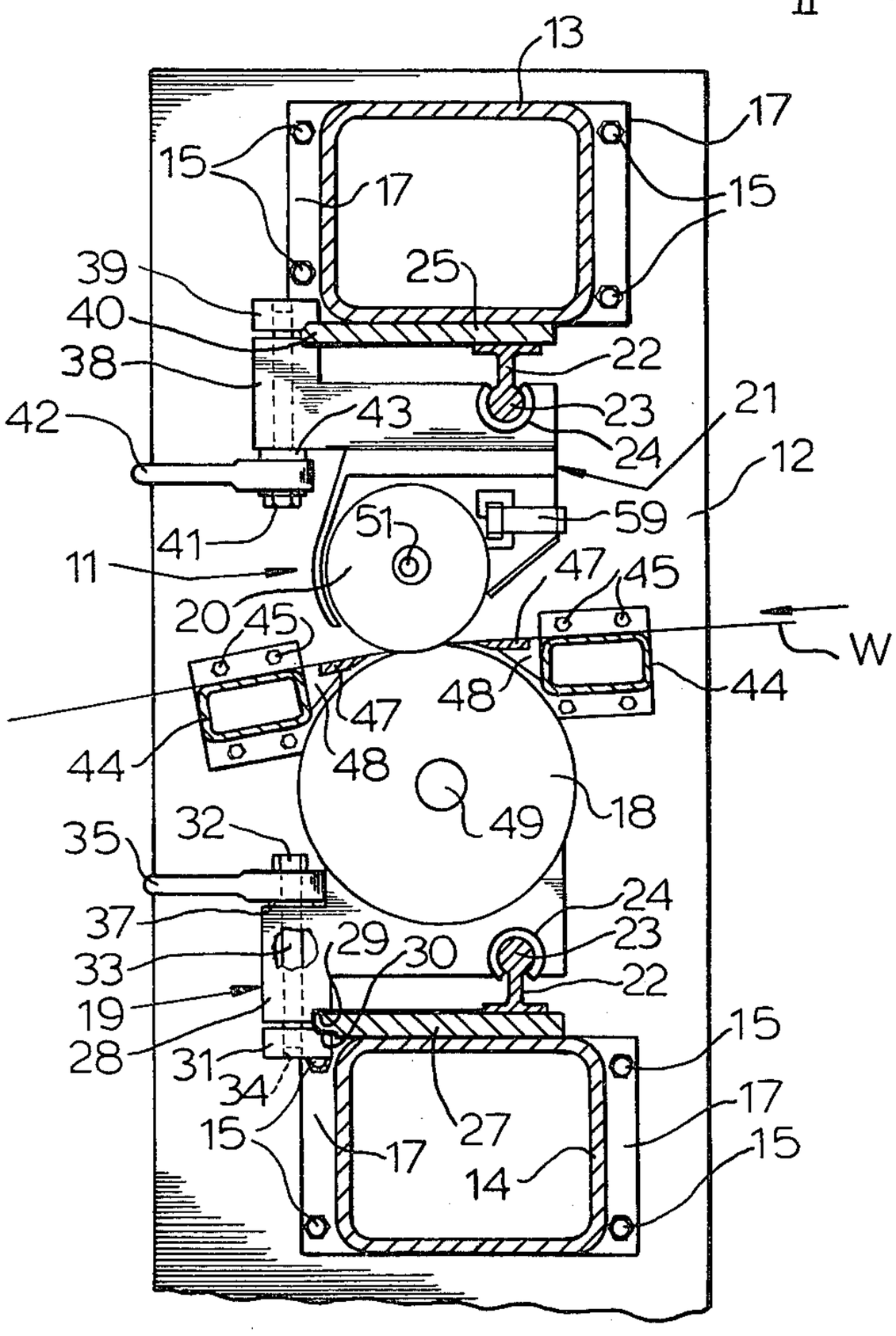
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W
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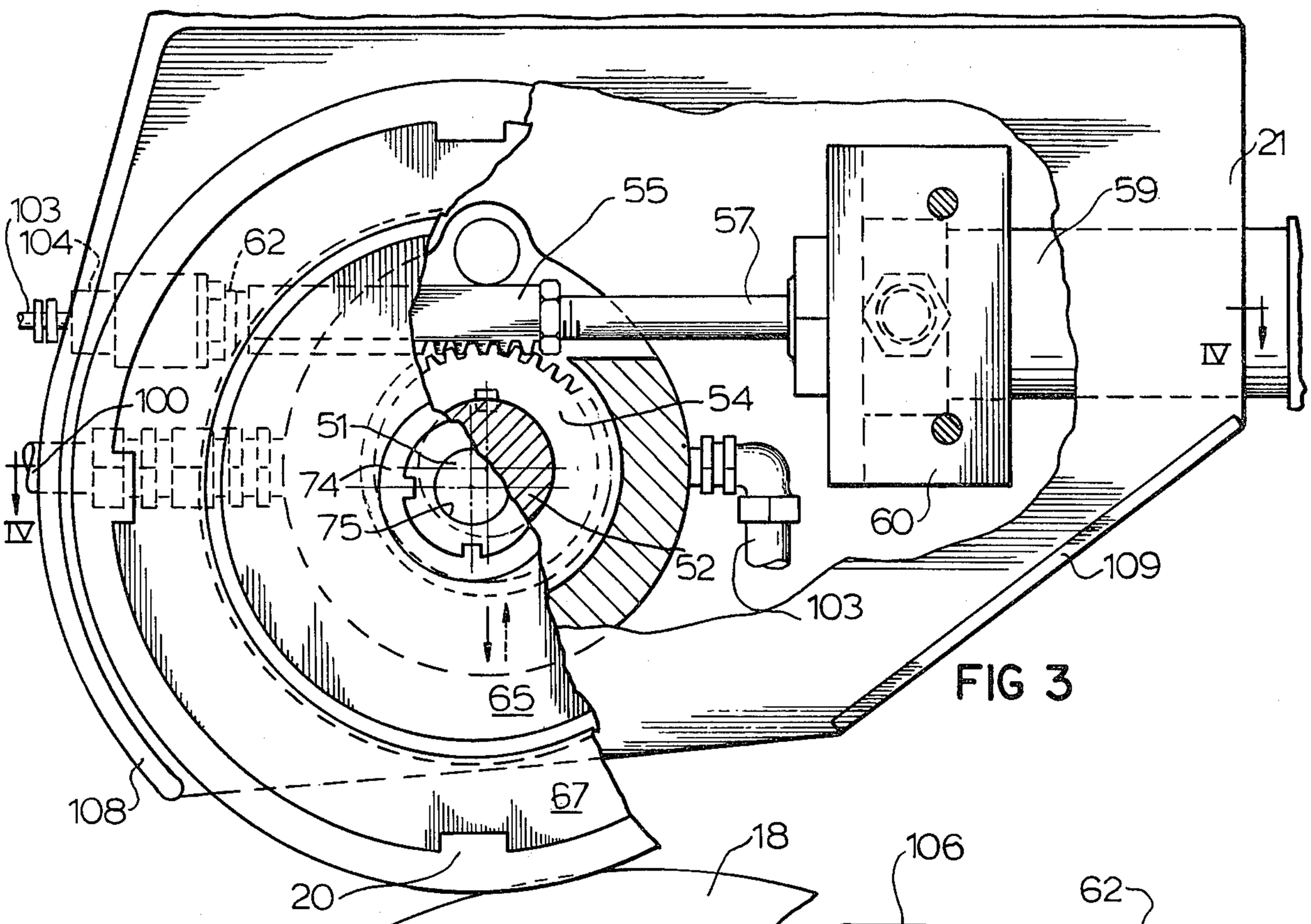
14

FIG 2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104
62
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59
21
IV
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51
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IV
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18
20
106
62
pres. reg.
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air source
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85
82
89
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52
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105
107
64
21
73
72
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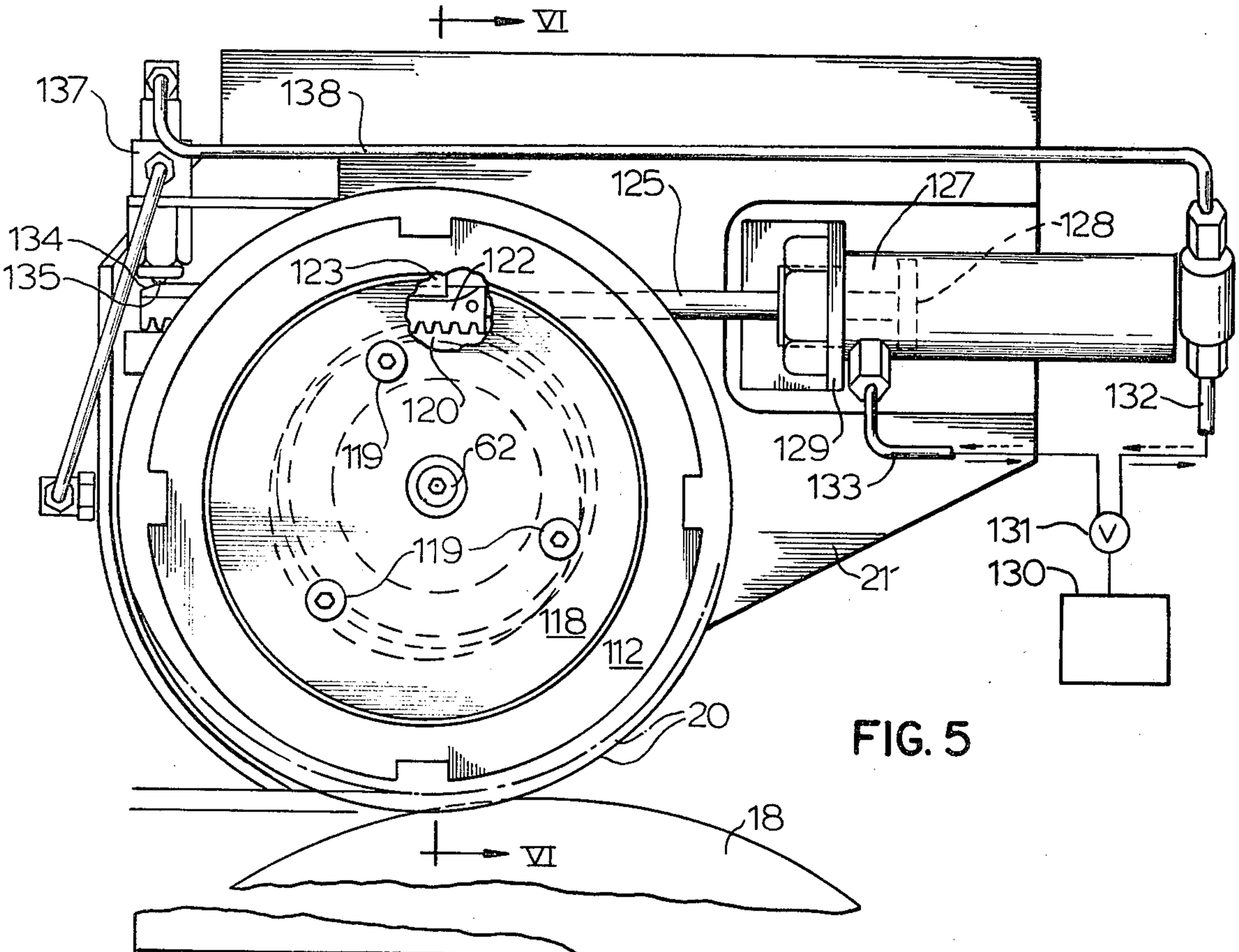
65

FIG 3

FIG 4


VI
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62
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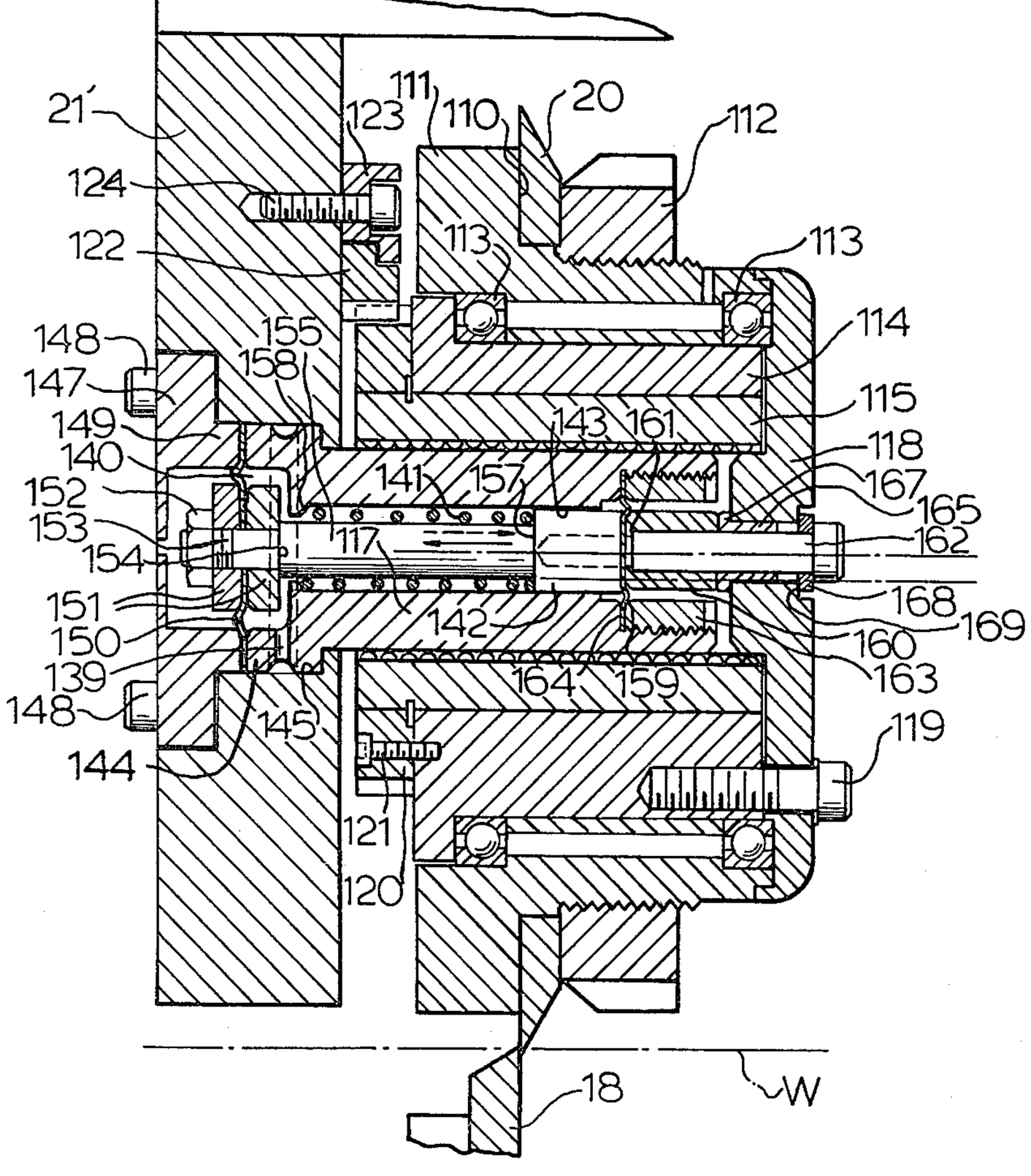
V
130
21'
VI
18

FIG. 5


21'
111
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153
117
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151
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160
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164
159
163
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145
119
144
121
120
18
W

FIG. 6

PREADJUSTABLE WEB SLITTER AND NON-DEFLECTING MOUNTING THEREFOR

This invention relates to web slitters, and is more particularly concerned with improvements in such slitters especially adapted for slitting running paper webs.

As is customary, web slitters comprise a lower slitter blade and an upper slitter blade which are supported on an adjustably movable mounting enabling the operator to relocate the entire assembly from side-to-side on the machine and to adjust the amount of overlap, i.e. depth of cut, the toe-in angle and the rake angle. Each time the slitter is relocated, it is necessary for the operator to check and adjust all of these settings.

The overlap adjustment has a substantial effect on the cut quality and the amount of dust produced at the slit line. Although the overlap setting is critical to cut quality, it is an adjustment that is difficult to make accurately by the machine operator. In practice the machine operator may employ a variety of overlap settings simply because he is unable to make the adjustment accurately.

Further, it has heretofore been deemed necessary to have the slitter blades set so that they overlap by about 0.050 to 0.060 inches, even though the quality of cut improves as this overlap distance is reduced. Heretofore, however, it has been deemed necessary to have the overlap of the extent just alluded to so that transient separating forces will not deflect the blade or mount to cause one blade to climb over the other.

Another problem that has been encountered in prior slitters involves the application of force or loading of the blades in axial direction toward one another. This force or load must be controlled accurately. Too little force will allow the web to force the blades apart and stop the cutting. Too great a force increases the tendency of one blade to climb on the other, and also increases the rate of blade wear.

A further problem encountered in prior slitters concerns the use of friction-type bearings for the side motion function. When an eccentric load, such as a side load at the perimeter of the blade is applied, the bearing tends to cock on its shaft and sliding friction is greatly increased. When small unavoidable amount of runout exists in either blade, the friction-type bearing binds, and the contact force between blades is greatly increased, thereby causing excessive blade wear.

All of the enumerated problems have substantially complicated web slitting and have been the cause of greater than desirable cost factor in the slitting process, especially aggravated in slitting of high bulk (thickness) webs.

An important object of the present invention is to overcome the disadvantages, drawbacks, inefficiencies, shortcomings and problems inherent in prior web slitters and to provide a new and improved slitter which will produce a high quality cut (minimize dust), substantially eliminate the need for operator adjustments, efficiently slit maximum bulk webs, and minimize blade wear.

Another object of the invention is to provide a web slitter having new and improved rigid mounting.

Still another object of the invention is to provide new and improved rotatable support for web slitters.

A further object of the invention is to provide new and improved adjustment means in web slitters.

A still further object of the invention is to provide new and improved blade loading means in web slitters.

The present invention provides a slitter comprising a lower blade carried rotatably by a lower blade head and an upper blade carried rotatably by an upper blade head, the blades being cooperative to slit a running web. Means support the heads adjustably relative to one another and transversely relative to the path of the running web and preferably comprise generally vertically spaced lower and upper rigid parallel head-supporting elongate rail means arranged to extend transversely relative to the web to be slit. Means mount the lower head on the lower rail means for rigid support thereby but adapt the lower head for adjustment along the length of the lower rail means and means mount the upper head on the upper rail means for rigid support thereby but adapt the upper head for adjustment along the length of the upper rail means and relative to the lower head. There are means for respectively releasably locking the heads in rigid adjusted positions along said rail means.

There may be means mounting one of the blades for movement relative to its carrying head for movement into and out of slitting cooperation with the other of the blades, means normally biasing the one blade out of the slitting cooperation, and means operative for overcoming the biasing means for selectively holding the one blade in slitting cooperation with the other blade.

Eccentric shaft means may mount one of the blades on its blade head, with means for actuating the eccentric shaft means rotatably for moving said one blade into and out of web slitting relation to the other of the blades.

Desirably means mount one of the blades on its blade head for movement relative to its blade head and relative to the other blade, fluid operated control means movably controlling the position of said one blade relative to the other blade.

Anti-friction bearing means are adapted for rotatably mounting at least one of the blades on the head carrying the same. Such anti-friction bearing means comprise respective annular anti-friction bearings axially spaced apart and located at respectively opposite sides of a plane through the edge of said one blade.

Other objects, features and advantages of the invention will be readily apparent from the following description of certain representative embodiments thereof, taken in conjunction with the accompanying drawings although variations and modifications may be effected without departing from the spirit and scope of the novel concepts embodied in the disclosure and in which:

FIG. **1** is a fragmental front elevational view of a slitter embodying the invention;

FIG. **2** is an enlarged fragmental vertical sectional detail view taken substantially along the line II—II of FIG. **1**;

FIG. **3** is a substantially enlarged fragmentary elevational view, partially broken away and in section, taken substantially in the plane of line III—III of FIG. **1**;

FIG. **4** is a sectional plan view taken substantially along the line IV—IV of FIG. **3**;

FIG. **5** is a fragmentary elevational view similar to FIG. **3** but showing a modification; and

FIG. **6** is a sectional detail view taken substantially along the line VI—VI of FIG. **5**.

By way of example (FIG. **1**) a slitter installation **10** is depicted in which a plurality of slitters **11** is adjustably mounted to slit a web W of any desired initial width into

a plurality of separate narrower lengths. In a paper web processing line, the slitter installation **10** may be conveniently located between a web source, such as a supply roll or between a calender downstream relative to a paper making machine, and a winder in which the slit separated lengths of the web are wound into respective rolls. As shown, the slitter installation **10** comprises a supporting frame having suitably spaced rigid uprights **12** which support between them vertically spaced upper and lower blade support cross beams **13** and **14**, respectively, which may be secured fixedly to the uprights **12** as by means of bolts **15** securing respective attachment flanges **17** at the opposite ends of the beams **13** and **14** to the uprights **12**. In a preferred construction, the cross beams **13** and **14** are of rigid hollow generally rectangular cross section and of a coextensive length to extend entirely across and slightly beyond the opposite edges of the web W.

Each of the slitters **11** comprises a lower blade **18** carried rotatably by a lower blade head **19**, and an upper blade **20** carried rotatably by a upper blade head **21**. Each of the blade heads **19** and **21** is constructed and arranged to be mounted on its associated supporting beam **14** and **13**, respectively, for ready selective adjustment along the length of the beam. For this purpose, each of the beams **13** and **14** has rigidly attached thereto a respective elongate rail **22** of a length to extend throughout the anticipated span along which the slitters **11** are expected to be supported adjustably. In a preferred form, each of the tracks **22** has a bulbar rail head **23** engaged slidably about more than 180° of the head perimeter by a complementary slotted tubular bearing bushing **24** on each of the heads **19** and **21**. As best seen in FIG. **2**, the rail **22** on the upper beam **13** projects downwardly from a rigid bed plate **25** to which the rail is secured as by means of welding and which plate is rigidly secured as by means of welding to the underside of the beam **13**. To the same effect the lower rail **22** projects upwardly from the beam **14** and is secured as by means of welding to a bed plate **27** secured as by means of welding to the upper face of the beam **14**.

Means are provided for fixedly but releasably locking each of the heads **19** and **21** in position on its supporting beam. For this purpose, the lower head **19** has a clamping foot **28** having a rabbet groove **29** within which is received the upper side of a forwardly projecting clamping lip **30** on the base plate **27**. Similarly, a clamping block **31** engages the underside of the lip **30**. Means for effecting clamping coaction of the clamping foot and block **31** comprise an elongate bolt **32** extending freely through a bore **33** in the foot **28** and having a distal end portion threadedly engaged in a tapped bolt hole **34** in the clamping block **31**. A handle **35** fixedly secured to the head end portion of the bolt **32** extends radially from the bolt and is adapted to be manipulated for rotating the bolt for drawing the clamping block **31** toward the foot **28** and into clamping retaining engagement of the lip **30** by and between the clamping shoulders provided by the foot **28** and the block **31**. A thrust washer **37** between the butt end of the handle **35** and the adjacent end of the foot **28** facilitates selective turning of the handle **35** into and out of clamp closing and clamp opening positions. Through this arrangement, the slitter head **19** is adapted to be infinitely incrementally adjusted along the length of the track **22**.

To the same effect, infinitely incremental adjustment of the slitter head **21** is adapted to be effected along its track **22** by a similar clamping device comprising a foot **38** on the head **21** cooperating clampingly with a clamping block **39** to grip therebetween a clamp lip **40** projecting forwardly on the bed plate **25**. A clamp bolt **41** extends freely through the foot **38** and has its distal end portion threadedly engaged in a complementary threaded bolt hole in the block **39**. A handle **42** fixed to the head end of the bolt **41** is adapted to be manipulated for operating the bolt and has its butt end in engagement with a thrust washer **43**. Through this arrangement, the upper blade head **21** is readily adjustable along its rail **22** relative to the lower head **19** in whatever adjusted position the lower head may be along its rail **22**. Upon closing the clamp for the head **21** similarly as closing the clamp for the head **19**, the head is locked positively and rigidly in the desired blade operating position, and the rigid rails will withstand great thrust forces or pressures that may be generated by and between the blades **18** and **20**, without any detrimental yielding, but positively retain the blades **18** and **20** in their web slitting relationship.

For guiding the web W through the slitter station frame provided between the uprights **12** and between the beams **13** and **14**, and in slitting plane through the slitters **11**, supporting means are provided comprising flat topped web supporting bars **44** which extend parallel to the beams **13** and **14** from side to side between the uprights **12** and are secured to the uprights **12** as by means of attachment flanges attached to the uprights **12** by means of bolts **45**. One of the web guiding bars **44** is located upstream in adjacent relation to the lower slitter blade **18** and another of the bars **44** is located downstream in adjacent clearance relation to the lower slitter blade **18**. Respective supporting surface extension plates **47** are carried by the bars **44** on brackets **48** to close the gap between the tops of the bars and the slitting laps of the slitter blades **18** and **20**. At their edges nearest the slitting laps, the plates **47** are chamfered for clearing the blade **18** but approach as close as practicable to the slitting laps of the blades.

Freely idling rotary mounting of the lower slitter blade **18** of each of the slitters **11** is desirably effected by means of a respective shaft **49** which may be rotatably supported by the head **19** and carries a backing disk **52** to which the blade **18** is secured in any desired manner.

Means are provided enabling an optimum slitting cooperation of the slitter blades to be critically preadjusted at the factory during assembly of the units so that the blades will not require readjustment throughout the life of the unit. This includes overlap of the blades, where that is desired, toe-in angle and rake angle. Nevertheless, the blades are separable when necessary without losing the enumerated critical adjustments when the blades are brought back into slitting relationship. As indicated in FIG. **3**, the upper slitter blade **20** is adapted to be lowered into slitting relation to the lower blade **18** as indicated by solid directional arrow and is adapted to be raised from the slitting relationship as indicated by the dash-line directional arrow. In addition, the blade **20** is adapted to be moved between a side loading slitting thrust relationship to the lower blade **18** as indicated by solid directional arrow in FIG. **4** and a backed off, separated relation to the lower blade **18** as indicated by dashed directional arrow. For raising and lowering the blade **20** it is rotatably mounted on an eccentric extension **51** of a supporting shaft **52** which is rotatably journaled in a linear rotary anti-friction bearing **53** carried by the head **21**. At its end opposite the eccentric **51**, the shaft **52** carries a pinion **54** fixedly keyed thereto, mesh-

ing with a rack **55** to which is connected a piston rod **57** extending from a piston **58** within an air cylinder **59** mounted at its base end to the head **21** as by means of an angular foot mount **60**. In this instance the piston **57** is double acting in the cylinder **59**. An air line **61** leads from an air source **62** through a control valve **63** and thence through one branch to the head end of the cylinder **59** and through another branch to the base end of the cylinder. By operating the control valve **63** to charge air into the head end of the cylinder, the piston **58** is driven toward the base end of the cylinder and thus in a direction to turn the shaft **52** for eccentrically shifting the blade **20** into slitting relation to the blade **18**. When it is desired to raise the blade **20** into non-slitting clearance relation to the blade **18**, the base end of the cylinder **59** is charged with compressed air from the compressed air source **62**, under the control of the selectively operable control valve **63**. Air pressure introduced into this cylinder **59** behind the piston **58** drives the piston toward the head end of the cylinder **59** and causes the reciprocable rack **55** to rotate the pinion **54** for turning the shaft **52** clockwise as seen in FIG. **3**, whereby to lift the blade **20**. By reversing the air pressure in the cylinder **59**, the pinion **58** reverses and causes the rack **59** to turn the pinion **54** and thus the shaft **52** in the blade lowering direction, i.e. counterclockwise in FIG. **3**.

The exact degree of overlap of the blade **20** relative to the blade **18**, i.e. the depth of slitting cut, is accurately controlled by means on an end stop **64** engaged by the distal end of the rack member **55** under the thrust of the biasing piston **58**. In other words, the blade overlap can thus be accurately preset and maintained throughout repeated raising and lowering of the blade **20** relative to blade **18**.

By the arrangement just described, unusually narrow overlap settings of the blades **18** and **20** can be maintained with accuracy. Overlaps as low as 0.015 to 0.020 inch, or even no overlap for slitters operating on the principle of simply crushing the web fiber between the severing edges of the blades are practical by use of the present invention primarily because of the rigidity with which the slitter heads **19** and **21** are supported, the rigid beams **13** and **14** being located directly under and over the axes of the blades **18** and **19**, and thus there is no chance for cantilever deflection as has been a problem with prior slitters. Accordingly, the critical adjustments in the functional cooperation of the slitter blades can be preset during manufacture of the slitters and need not be readjusted throughout the life of the unit.

Contributing further to the efficiency of the slitters **11** in each instance is the reduction in bearing load and reduction in rotational friction to a minimum provided by the rotary mounting of the slitter blade **20** on the spindle **51**. To this end, the blade **20** is formed as a readily replaceable ring element provided with a suitable outer perimeter edge, such as a conventional beveled edge. The blade ring is mounted on and about a peripherally threaded hub **65** onto which is threadedly engaged a suitable lock nut **67** by which the blade is clampingly secured to an annular lateral flange **68** on the inner end of the hub, with just enough of the cutting edge portion of the blade **20** projecting beyond the perimeter of the flange **68** to attain adequate depth of cut. Removal of the blade **20** for sharpening or replacement is thus facilitated.

Anti-friction free rotary mounting of the hub **65** on the spindle **51** is effected in a manner to reduce bearing load and to reduce rotational friction to a minimum. For this purpose, respective sets of bearings **68***a* located adjacent to respectively opposite ends of a central bearing bore **69** in the hub **65** mount the hub. Although the bearings **68***a* may be roller bearings, another efficient form is ball bearings as shown in which the bearing balls are operative in radially inner and radially outer races. Respective inner and outer spacer bushings **70** and **71** extend between and maintain the inner and outer races of the bearings **68***a* spaced apart a desired distance within the bore **69** to position the bearings **68***a* at respectively opposite sides of a plane through the cutting edge of the blade **20**. Fixed stops for the inner and outer races, respectively, of the inner of the bearings **68** are provided by a radially outwardly projecting annular shoulder flange **72** on the inner end of the spindle **51** and by a radially inwardly extending annular shoulder flange **73** on the hub **65** at the inner end of the bore **69**. At the outer end of the bore **69**, the inner race of the outer of the bearings **68** is thrust toward and against the inner spacer bushing **70** by a lock nut and washer assembly **74** secured about a threaded outer end portion **75** on the spindle **51**. Means such as a snap-in lock ring **77** secures the outer race of the outer bearing **68***a* in thrusting engagement with the outer spacer bushing **71**.

A new and improved side loading system for the slitter blade **20** is provided by fluid operated actuator means **78** (FIG. **4**) by which the shaft **52** is adapted to be controlled for a limited range of reciprocal movement. Such reciprocal movement of the shaft **52** is facilitated by means of the linear rotary anti-friction bearing **53** which affords smooth movement of the shaft with no stick-slip condition and enables the unit to move freely to follow blade run-out and to maintain side loading very accurately as a function of applied fluid pressure, such as air pressure.

In a desirable construction, the actuator **78** comprises differential annular concentric fluid pressure chambers **79** and **80** defined between an annular housing part **81** secured fixedly but replaceably to the head **21** as by means of bolts **82**, and a flanged tubular housing member **83** which is mounted by means of spaced bushing bearings **84** on and about a shoulder bolt **85** fixedly but releasably secured corotatively and coreciprocally on the inner end of the shaft **52** about which the pinion **54** is keyed. Between the housing portions **81** and **83**, the differential pressure chambers **79** and **80** are enclosed between a common intermediate separating diaphragm **87**, while the opposite side of the chamber **79** is closed by a diaphragm **88** and the opposite side of the chamber **80** is closed by a diaphragm **89**. Differential volume of the chambers **79** and **80** is attained by an assembly of differential spacer rings comprising radially inner and radially outer rings **90** and **91**, respectively, for the chamber **79** and radially inner and outer rings **92** and **93**, respectively, for the chamber **80**. The diaphragm **88** is clamped between radially spaced shoulders on the inner ends of the housing members **81** and **83** and the spacer rings **90** and **91**. The diaphragm **87** is clamped between the spacer rings **90** and **91**, and the spacer rings **93** and **94**. The diaphragm **89** is clamped between the spacer rings **93** and **94** and a clamping ring **95** secured to the housing member **81** by the bolts **82**, and a clamping ring **97** secured by a lock nut **98** threaded onto the outer end of the housing member **83**. Through this arrangement, the stack of spacers and diaphragms is firmly secured in place on respectively the housing members **81** and **83**.

Means are provided for constantly pressurizing the pressure chamber **79**. To this end a pressure inlet port **99** leads to the chamber **79** and is supplied through a conduit **100** connected to compressed air source **62**. Sufficient air leakage is provided for past the clamping spacer **91** to permit free passage of air from the part into the chamber **79**. The pressure action in the chamber **79** functions to bias the blade carrying shaft **52** normally in the blade racking off or separating direction, that is in the direction of the dashed directional arrow in FIG. **4**. A seal against leakage from the chamber **49** into the chamber **80** is effected as by means of O-ring **101**. A check valve **101***a* holds biasing air pressure within the chamber **79** when the air source **62** is shut down.

To overcome the bias of the fluid pressure in the chamber **79** for loading the blade **20** into slitting cooperation with the blade **18**, means are provided for selectively pressurizing the larger chamber **80** which is not only larger diametrically but also axially than the chamber **79**. For this purpose, an inlet port **102** leads through the housing **81** into the chamber **80** and through clearance past the clamping ring **93**, pressure fluid being supplied through a pressure line **103** connected with the pressure source **62** and controlled by a normally closed valve assembly **104** mounted on the head **21** through a foot bracket **105** in association with the stop **64**. A valve actuator **107** projects from the stop **64** into the path of the distal end of the rack **55** acting as a plunger so that when the rack **55** is biased into the stop **64**, the valve actuator **107** opens the valve **104** and thus opens the pressure line **103** to the source **62**. As a result, the pressure chamber **80** is pressurized and the diaphragm **89** causes the shaft **52** to be biased in opposition to the pressure chamber **79**, that is in the direction of the solid directional arrow in FIG. **4** and thereby loads the slitter blade **20** into slitting cooperation with the lower slitter blade **18**. By means of a pressure regulator **106**, the magnitude of the side loading force applied to the blade **20** may be substantially accurately maintained proportional to air pressure. It will thus be apparent that the cylinder **59** has the dual functions of controlling both the raising and lowering of the blade **20** through the rack and pinion mechanism, and the slitter loading of the blade **20** through the rack plunger and the valve **104**.

It may be noted that the head **21** is provided with guard flanges **108** and **109** which project axially relative to and in spaced relation about the blade **20** and are of a width which is great enough to maintain a guarding relationship to the edge of the blade throughout its range of axial displacement, that is between the loaded position of the blade **20** relative to the blade **18** and the backed-off position of the blade **20**.

In the modification of FIGS. **5** and **6**, the general structural organization and relationships are generically substantially the same as in FIGS. **3** and **4**, except that the mounting and control of the blade **20** on the head **21'** are specifically different. In FIGS. **5** and **6**, the blade **20** is releasably secured to an axially facing shoulder **110** on a hub **111** by means of a lock nut **112** threadedly secured on the hub. Axially spaced anti-friction bearings **113** rotatably mount the hub **111** on and about an eccentric bushing **114** rotatably and axially movably mounted through a linear rotary anti-friction bearing **115** on a spindle shaft **117** which is secured fixedly to the head **21'**. A cover plate **118** extends in retaining relation to the bearings **113** and is removably secured to the eccentric bushing **114** as by means of bolts **119**.

Selective oscillatory rotation of the eccentric bushing **114** is adapted to be effected by means of a pinion **120** fixedly secured as by means of screws **121** to the inner end of the bushing **114** and in mesh with a rack bar **122** guided for reciprocal movement as by means of a guide rail **123** secured as by means of screws **124** to the head **21'**. At one end, the rack **122** is attached to a piston rod **125** projecting from a double acting pressure fluid cylinder **127** having therein a piston **128** attached to the piston rod **125**. Support for the cylinder **127** is provided by a foot bracket **129** carried by the head **21'**. Pressure fluid such as compressed air supplied from a source **130** is controlled through a valve **131** to enter through a pressure line **132** into the cylinder **127** to act on the head end of the piston **128**, while a pressure line **133** extends from the valve **131** to communicate through the cylinder **127** with the piston rod side of the piston **128**. When the valve **131** is set to direct air into the piston head end of the cylinder **127**, the rack **122** is driven towards the left as viewed in FIG. **5**, whereby to operate the rack and pinion for moving the blade **20** into slitting relation with the blade **18** as shown in full outline in FIG. **5**, whereas when the valve **131** is operated to direct air to the piston rod end of the piston **128**, the rack and pinion are operated to rotate the eccentric bushing **114** to move the blade **120** upwardly as seen in FIG. **5** away from the blower blade **18**, depicted in dash outline in FIG. **20**.

Another important function of the cylinder and piston actuator **127**, **128** is to control through the rack **122** serving as a plunger, automatic side loading of the blade **20** when it is in proper depth of cut slitting overlap with the lower blade **18**. To this end, at the end of projection stroke, that is top blade lowering function, a cam surface **134** on the distal end portion of the rack bar plunger **122** engages and depresses a valve opening plunger **135** which opens a normally closed valve **137** interposed in a pressure fluid conduit **138** connected to the pressure fluid supply line **132** and leading through the valve **137** to an inlet **139** (FIG. **6**) from which the pressure fluid is discharged into a pressure chamber **140** for overcoming the biasing effect of a coil compression spring **141** which normally acts to back the blade **20** axially away from the blade **18**. As best seen in FIG. **6**, both the chamber **140** and the biasing spring **141** are associated with a plunger **142** which is reciprocally slidably mounted in an axial bore **143** in the shaft **117** which is fixedly secured to the head **21'**. A shouldered base **144** on the shaft **117** is secured fixedly in place in a complementary shouldered recess **145** in the head **21'** by means of a cover member **147** removably secured in place to the head member **21'** as by means of screws **148**. The cover member **147** has an axially extending annular clamping portion **149** which clamps a flexible diaphragm **150** to the adjacent end of the shaft base **144**. Attachment of the diaphragm **150** to the plunger **142** is effected by means of a pair of clamping washers **151** secured in place as by means of a lock nut **152** threaded on a reduced diameter portion **153** on the adjacent end of the plunger **142** and having at its base a shoulder **154** against which the clamping washers **151** are thrustingly tightened by the nut **152**. In this instance, the inner of the washers **151** serves as a pressure responsive piston together with the diaphragm **150** which closes off the outer end of the chamber **140**. A substantial pressure area differential is provided by the diaphragm **150** and piston compared to the diameter of a diaphragm **159** at the other end of the bore **143** so that when the chamber

140 is pressurized, the pressure fluid will drive the plunger 142 toward the left as viewed in FIG. 6 and as indicated by the full line directional arrow. Upon closing of the valve 137 the chamber 140 is depressurized, and the spring 141 drives the plunger 142 a limited distance toward the right as viewed in FIG. 6 and as indicated by the dashed directional arrow. A reduced diameter portion 155 on the plunger 142 accommodates the biasing spring 141 which at one end thrusts against a shoulder 157 on the plunger 142 and at its opposite end thrusts against a shoulder 158 on the shaft 117 adjacent to the chamber 140. Leakage past the full diameter portion of the plunger 142 is prevented by the diaphragm 159 acting as a closure and which is clamped against the end of the plunger by means of a thrust bushing 160 having an inturned annular flange 161 engaged by a shoulder screw 162 threadedly connected axially to the adjacent end of the plunger 142 against which the inner margin of the diaphragm 159 is thus clamped. At its outer margin, the diaphragm 159 is securely clamped by a ring nut 163 which clamps the diaphragm against an opposing axially facing shoulder 164 on the shaft 117. A bushing bearing 165 permits free rotation of the cover 118 about the bolt 162 and has a radially outwardly projecting annular coupling flange 167 which provides a thrust connection between the fixed bushing 160 on the bolt 162 and the cover 118. A thrust washer 168 between the head of the bolt 162 and a shoulder 169 on the cover 118 assures positive side loading thrust through the bolt to the cover and thus to the blade 20 when the pressure chamber 140 is pressurized.

In the arrangement of FIGS. 5 and 6, similarily as in the arrangement of FIGS. 3 ad 4, all of the blade setting parameters, i.e. blade lap or depth of cut, rake angle and toe-in are adapted to be permanently set at the time the head 21′ is factory assembled, thus avoiding need for effecting such settings in the field, or even effecting readjustments or resettings. This is true even if the blade 20 needs to be replaced.

Further, in both embodiments automatic side loading of the upper slitter blade is effected when the appropriate valve, i.e. 104 or 137 is opened at the extreme or end of thrust of the rack plunger which effects the desired slitting cooperative relation of the blades.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

I claim as my invention:

1. In a slitter comprising a lower blade carried rotatably by a lower blade head and an upper blade carried rotatably by an upper blade head, said blades being cooperative to slit a running web:

a supporting frame having generally vertically spaced lower and upper rigid parallel beams located, respectively, to underlie and overlie the web transversely in substantially spaced relation to the web, and each of said beams having a respective face which is directed toward the web; said lower beam having means on its said face for supporting said lower blade head under the web for selective adjustment longitudinally along the beam and transversely relative to said web;

said upper beam having means on its said face for supporting said upper blade head for selective adjustment longitudinally along said upper beam and transversely relative to the web;

at least one of said beams having a bed plate fixed to its said face and extending therealong for a distance substantially as long as the width of said web, and having a lip along its length projecting horizontally from one side of said one beam;

a rail fixed on said bed plate and projecting toward the web and extending throughout substantially the length of said bed plate;

the blade head supported by said one beam having means thereon engaging said rail for longitudinal adjustment movement along the rail; and

said one beam blade head having a surface thereon engaging one side of said lip, a clamping element engaging the opposite side of said lip, and means for releasably drawing said clamping element and said one beam head toward one another and thereby effecting a clamping engagement of said lip between said head surface and said clamping element for maintaining said one beam blade head in selected adjusted position along said rail and said one beam and relative to the other of said blade heads.

2. A slitter according to claim 1, wherein each of said beams has on its face one of said bed plates and one of said rails, and each of said blade heads has said means engaging its associated bed plate rail and a respective said clamping surface and clamping element and means for drawing the clamping surface and clamping element toward one another for selectively clampingly gripping the associated bed plate lip.

3. A slitter according to claim 2, wherein said means for drawing the clamping element and blade head toward one another, for each of said blade heads, comprises a bolt having a handle at one end for turning the bolt, and said bolt having a shank extending through the clamping surface on the associated blade head and having its opposite end threaded into the associated clamping element, whereby to effect said releasable clamping by manipulation of the associated handle.

4. A slitter according to claim 2, wherein elongate shaft means carried by said upper blade head has the upper blade attached to one end of the shaft mean, means attached to the opposite end of the shaft means for selectively shifting the upper blade by means of said shaft means in an axial direction relative to the lower blade, means for raising and lowering said upper blade relative to said upper blade head and relative to the lower blade and comprising eccentric means about said shaft means and a pinion located intermediate said ends concentric with the fixed to said shaft means and a rack meshing with said pinion and extending on an axis normal to said shaft, and means for selectively driving said rack reciprocably to rotate said gear and thereby said shaft and effecting said raising and lower of said upper blade by operation of said eccentric means in the rotation of the shaft means.

5. A slitter according to claim 4, including means controlled by said rack for controlling operation of said means for shifting said upper blade axially.

6. A slitter according to claim 5, wherein said rack controlled means comprises a fluid pressure system provided with a valve having means operated by said rack for operating the valve, and a pressure fluid operated device effective by operation of the valve for effecting shifting of said upper blade.

7. A slitter according to claim 1, wherein one of said blade carrying heads has a hollow fixed shaft, an annular blade support rotatably mounted on and about said

fixed shaft and carrying an annular slitter blade, a plunger extending through said hollow fixed shaft, one end of said plunger having means rotatably connected thereto and attached corotatively to said rotatable blade supporting means and adapted for axial reciprocation with said plunger, and means at the opposite end of said plunger for effecting selective reciprocations of the plunger for thereby shifting said blade in axial direction relative to said fixed shaft.

8. A slitter according to claim **7**, wherein said means rotatably supporting said blade on said fixed shaft includes an eccentric device for effecting adjustment of said blade transversely relative to the axis of said fixed shaft, and means for operating said eccentric device.

9. A slitter according to claim **8**, wherein said means for operating said eccentric device comprises a pinion attached to said eccentric device, and a rack meshing with said pinion and having means for selectively reciprocating the rack to turn said pinion and thereby effecting operation of said eccentric device.

10. In a slitter according to claim **1**, wherein said rail has a bulbar cell head, and said one beam blade head has a complementary slotted tubular bearing bushing engaging the rail head for slidable adjustment along the rail head.

11. In a slitter having a lower blade carried rotatably by a lower blade head and an upper blade carried rotatably by an upper blade head, said blades being cooperative to slit a running web, means for supporting said heads adjustably relative to one another and transversely relative to the path of the running web, means mounting one of said blades for movement relative to its carrying head into and out of slitting cooperation with the other of said blades, means normally biasing said one blade out of said slitting cooperation, and means operative for overcoming said biasing means for selectively holding said one blade in slitting cooperation with said other blade, the improvement comprising:

shaft means mounting said one blade on its associated blade head and having both of said biasing means and means operative for overcoming said biasing means located at one end portion of said shaft means and said one blade connected to the opposite end portion of said shaft means;

eccentric means associated with said shaft means between said opposite end portions;

a pinion connected with said eccentric means in a location between said opposite end portions;

a rack meshing with said pinion and mounted for reciprocation relative to said pinion;

and means for selectively actuating said rack for turning said pinion and thereby operating said eccentric means for effecting said movement of said one blade into and out of said slitting cooperation.

12. A slitter according to claim **11** wherein means for supporting at least one of said blade heads comprises a rigid beam mounted to extend across the running web, a bed plate fixed to said beam and facing toward the web, an edge portion of said plate providing a lip projecting from and along one side of said beam, a rail rigid with said base plate and running therealong spaced from said lip and projecting toward the web, said one blade head having tracking means engaging said rail for movement of said one blade head adjustably longitudinally along said rail, said one blade head having a clamping surface engaging the face of said lip which faces toward the web, a releasable clamping element engaging the opposite face of said lip, and means for effecting selectively clamping engagement of said element with said lip or release of the clamping element, whereby when the clamping element is released said one head can be adjusted longitudinally along said rail and when the clamping element is in said clamping engagement said one blade head will be held in selected position relative to the other of said blade heads.

13. A slitter according to claim **11**, including means controlled by said rack for controlling operation of said means for overcoming said biasing means.

14. A slitter according to claim **13**, wherein said rack controlled means comprises a fluid pressure system provided with a normally closed valve having means operated by said rack for opening the valve, and a pressure fluid operated device effective by opening of the valve for overcoming said biasing means.

15. A slitter according to claim **12**, wherein said rail has a bulbar rail head, and said one blade head has a complementary slotted tubular bearing bushing engaging the rail head for slidable adjustment along the rail head.

16. In a slitter having a lower blade carried rotatably by a lower blade head and an upper blade carried rotatably by an upper blade head, said blades being cooperative to slit a running web, means for supporting said heads adjustably relative to one another and transversely relative to the path of the running web, means mounting one of said blades for movement relative to its carrying head into and out of slitting cooperation with the other of said blades, means normally biasing said one blade out of said slitting cooperation, and means operative for overcoming said means for selectively holding said one blade in slitting cooperation with said other blade, the improvement comprising:

said mounting means comprising hollow shaft means fixed on one end to said one blade carrying head;

tubular hub means extending rotatably about said fixed shaft means and thereby supporting said one blade for rotation about said fixed shaft means;

plunger means mounted reciprocably in said fixed shaft means and having rotary means extending past the distal end of said fixed shaft means for connecting said plunger means with said tubular hub means;

and means within the proximal end portion of said fixed shaft means and acting on the inner end portion of said plunger means for shifting the plunger means axially for effecting correponding axial movement of said rotary means and said tubular hub means and said one blade.

17. A slitter according to claim **16**, including a tubular eccentric between said tubular hub means and said fixed shaft means, and means for rotatably turning said eccentric relative to said fixed shaft means for thereby shifting said tubular hub means and said one blade radially relative to said fixed shaft means.

18. A slitter according to claim **17**, wherein said means for rotatably turning said tubular eccentric comprises a pinion attached to said eccentric means, a rack meshing with said pinion, and means for reciprocating said rack for turning said pinion and thereby turning said eccentric means for effecting said radial shifting of said tubular hub means and said one blade.

19. A slitter according to claim **18**, including means controlled by said rack for controlling operation of said means operative for overcoming said biasing means.

20. A slitter according to claim **19**, wherein said rack controlled means comprises a fluid pressure system

provided with a valve having means operated by said rack for operating the valve and a pressure fluid operated device in said means operated for overcoming said biasing means.

21. A slitter according to claim **17**, including means controlled by said rotatable turning means for controlling operation of said means for overcoming said biasing means.

22. In a slitter having a lower blade carried rotatably by a lower blade head and an upper blade carried rotatably by an upper blade head, said blades being cooperative to slit a running web, means mounting one of said blades on its blade head and including an eccentric, and means for actuating said eccentric rotatably for moving said one blade radially into and out of web slitting relation to the other of said blades, the improvement comprising: a pinion fixed to said eccentric, a reciprocable rack meshing with said pinion; actuator means for operating said rack, means normally active for biasing said shaft means and thereby said one blade in a blade separating direction, and means controlled by said rack for overcoming said biasing means for loading said one blade toward said other blade.

23. A slitter according to claim **22**, wherein said rack controlled means comprises a fluid pressure system provided with a valve having means operated by said rack for controlling the valve, and a pressure fluid operated device effective by the controlling of said valve for shifting said shaft means and thereby loading said one blade toward said other blade.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,380,945

DATED : April 26, 1983

INVENTOR(S) : Gerald A. Guild et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 10, line 50, "the" should read -- and --.

Signed and Sealed this

Twentieth Day of *September 1983*

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer

Commissioner of Patents and Trademarks